

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 435-01.PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB99/01516	International filing date (day/month/year) 02 August 1999 (02.08.99)	Priority date (day/month/year) 31 July 1998 (31.07.98)
International Patent Classification (IPC) or national classification and IPC C10B 53/00, 1/04, C04B 14/02, A62D 3/00, B01J 20/20, B01D 17/022		
Applicant HACKL, Eva, Maria		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 29 February 2000 (29.02.00)	Date of completion of this report 30 October 2000 (30.10.2000)
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

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I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages 1,3-15, as originally filed,
pages _____, filed with the demand,
pages 2,2a-2b, filed with the letter of 19 October 2000 (19.10.2000),
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1-17, filed with the letter of 19 October 2000 (19.10.2000),
Nos. _____, filed with the letter of _____.

☒ the drawings, sheets/fig 1,2, as originally filed,
sheets/fig _____, filed with the demand,
sheets/fig _____, filed with the letter of _____,
sheets/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

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IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☒ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☒ not complied with for the following reasons:

See supplemental sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.
- ☒ the parts relating to claims Nos. 1-15

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: IV

- 1). This report makes reference to the following documents:

D1 = FR-A-640 770
D2 = DE-A-43 03 842
D3 = GB-A-705 964
D4 = DE-A-37 41 110
D5 = US-A-5 783 046
D6 = US-A-1 586 306.

- 2). The various inventions/groups of inventions are:

i) Claims 1-15: method and system for pyrolysis of waste products containing hydrocarbons;

ii) Claim 16: a first use of pyrolysis carbon;

iii) Claim 17: a second use of pyrolysis carbon.

These three inventions/groups are not so linked as to form a single general inventive concept for the following reasons (PCT Rule 13.1):

The general concept linking independent Claims (1, 7), 16 and 17 is pyrolysis carbon.

This concept, however, is not inventive (see D1 or D2).

Since the applicant has not paid additional examination fees, only the first invention (Claims 1 to 15) was examined.

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-15	YES
	Claims		NO
Inventive step (IS)	Claims	1-15	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims		NO

2. Citations and explanations

3). The method (system) for pyrolysis of waste products containing hydrocarbons according to Claim 1 (7) of the application differs from that of D1 in that D1 does not disclose the following features of Claim 1 (7):

- only one pyrolysis furnace
- a double-walled furnace with a helically arranged hot air spiral duct, the hot air being guided in a spiral manner from the bottom to the top and drawn off at the upper end of the furnace, and the pyrolysis gases being discharged via a discharge pipe extending vertically from the furnace dome provided on the upper side.

Claims 1 and 7 and dependent Claims 2 to 6 and 8 to 15 therefore meet the requirements of PCT Article 33(2) (novelty).

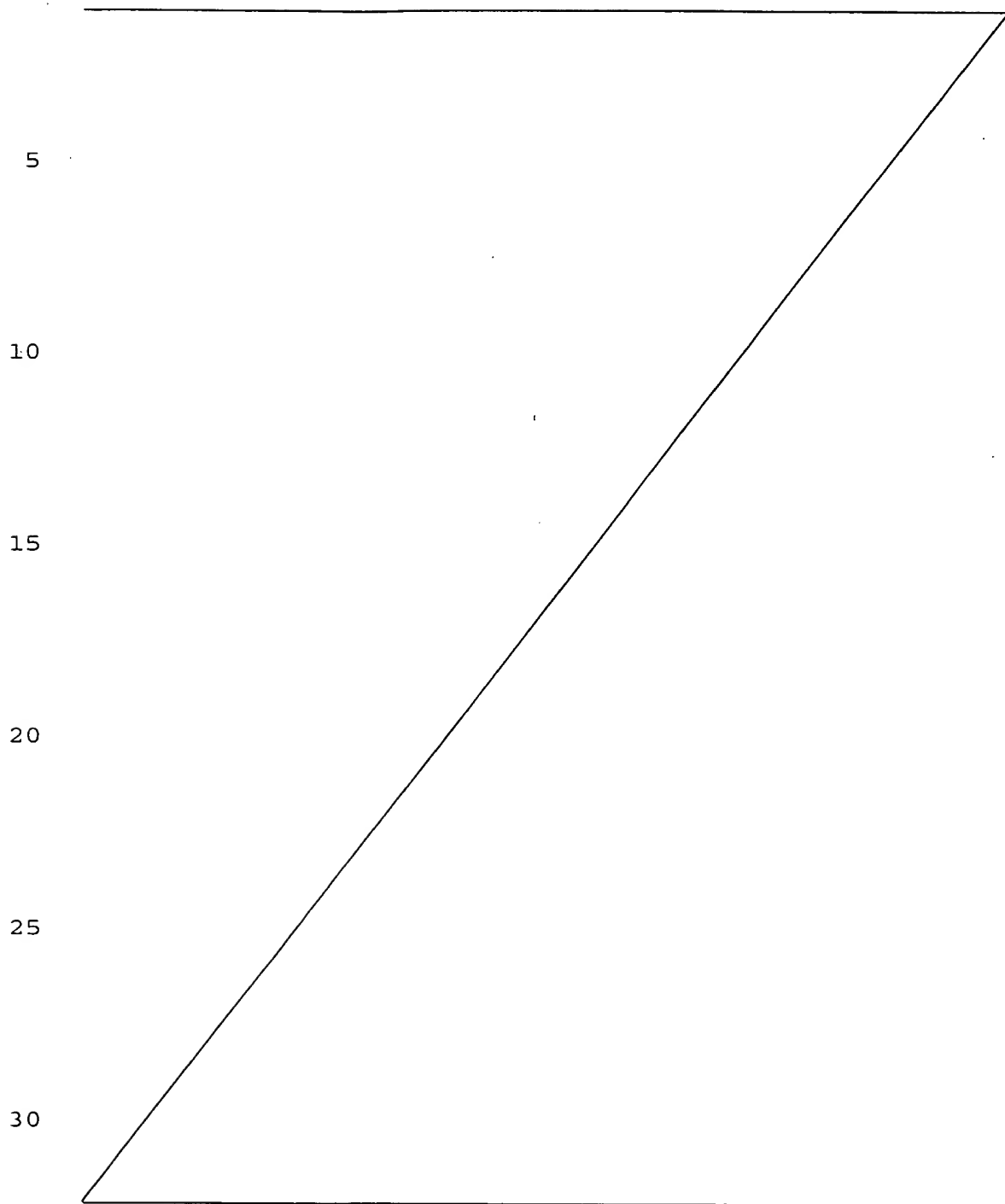
4). The heating fluid does not come into contact with the material to be pyrolyzed and therefore stays clean and can be fed back into the heating circuit. This is not possible in D1.

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Claims 1 and 7 as well as dependent Claims 2-6 and 8-15 therefore meet the requirements of PCT Article 33(3) (inventive step).



it is often difficult to maintain the appropriate flow conditions in the fluidized bed and, on account of the mass of material introduced, can easily be moved away from the equilibrium. For smaller, flexible embodiments which can easily be converted to different pyrolysis materials, these plants cannot be used.

Furthermore, what are known as continuous pyrolysis furnaces or fluidized-bed furnaces in which the material to be pyrolyzed is pyrolyzed either in
5 complete pieces or in comminuted form are described, for example in DE 44 47 357 A1, DE 29 25 202 A1, DT 25 20 754 A1 and DE 26 39 165 A1. These continuous pyrolysis furnaces are likewise of extremely complex structure are in each case designed for a specific type
10 and/or size of material and cannot readily be converted for different types of material.

Pyrolysis plants which are used to pyrolyze comminuted used tires or other organic waste materials are also
15 known, for example, from DE 27 24 813 A1, EP 0 477 187 B1 and DE 30 30 593 C2. These plants are in some cases of complex design and moreover cannot be used as an alternative, without special conversion work, both for whole used tires and for lumpy or bulk material.

20 Moreover, DE 31 38 128 C2 has disclosed a process for the thermal conversion of used tires into liquid and gaseous substances, in which a rolling truck which is laden with complete used tires is introduced
25 horizontally into a furnace, where the tires are treated with oil which has been heated to approximately 390° using the trickling technique.

FR 640 770 A has disclosed a plant for the distillation
30 of carbon-containing material which comprises a plurality of furnaces which are arranged in series and the respective bottoms of which can be removed in the downward direction. These bottoms are attached to vertical lifting devices, at the retracted, i.e. lower
35 position of which in each case one receiving container holding material to be treated can be fitted or removed and conveyed onward to the next furnace. The heat treatment takes place by pressing treatment fluid, such as superheated steam, into the respective furnace from

above, which fluid is discharged at the underside of the furnace in question, the distillation products which are contained in the steam in each case being removed by means of a "degreaser", after which the
5 fluid which has been cleaned in this way is fed back to the furnace in front under pressure from above. Therefore, the material to be treated and the treatment fluid pass in countercurrent from furnace to furnace, in each case with corresponding degreasing stations,
10 resulting in an extremely complex structure which requires large amounts of space and is therefore relatively uneconomical.

DE 37 41 110 A1 describes a cylindrical rotary
15 pyrolysis furnace, through the interior of which biological slurry is continuously passed, while hot gas is passed in the opposite direction inside a cavity which concentrically surrounds the rotary furnace on the outside. This device does not allow a rapid,
20 problem-free changeover of material which is to be pyrolyzed.

Moreover, US 5,783,046 A has disclosed a device for the distillation or pyrolysis of rubber or used tires, in
25 which the material is treated in two furnaces in succession, heating taking place in the first furnace and the final distillation or pyrolysis taking place in the second furnace. In this arrangement, used tires are bundled securely, in axial rows, into the horizontally
30 fed furnaces. In this case too, the structure of the known device is highly complex and therefore uneconomical.

US 1, 586,306 A describes a tunnel furnace in which the
35 comminuted material which is to be distilled is passed through the furnace on shelf trucks and passes through zones of different temperatures. This too is a relatively complex, uneconomic treatment of the material.

Finally, DE 43 03 842 A1 describes a process for eliminating environmental pollutants by adsorption with the aid of ground coal and coal products, which are scattered onto environmental pollutants, for example over oil which is on the surface of water. The coal product, which sucks itself full of oil, is then exposed to microorganisms and is left to ferment therewith, either remaining on the water surface in this way or being added to soils which can be plowed or to ground deposits. As a result, both relatively valuable products, namely the coal adsorbent and the oil, are lost. There is no provision for the oil to be recovered.

Therefore, it is an object of the invention to provide a process and a

PATENT CLAIMS

1. A process for pyrolyzing hydrocarbon-containing waste products, in particular used tires, in which

5 a) only one pyrolysis furnace (1) is provided, the material which is to be pyrolyzed being introduced into or onto a receiving device (40, 50) in a loading station outside the furnace (1),

10 b) the receiving device (40, 50) is then introduced from below into a pyrolysis furnace which is open at the bottom, at the same time tightly closing the furnace (1),

15 c) after which the furnace (1), by means of burners (7), is externally heated to the pyrolysis temperature of approximately 500°C and the pyrolysis is carried out completely,

20 the hot air being passed helically from the bottom upward in the pyrolysis furnace (1), which is designed as a double-walled furnace with a helically arranged hot-air helical duct (6), and being extracted at the upper end of the furnace,

and the pyrolysis gases being discharged via a discharge pipe (20) which leads vertically out of the furnace dome (10) provided at the top side,

into receiving containers (51) which can be stacked vertically on top of one another and are easy to remove.

5. The process as claimed in claim 3, characterized in that
5 the receiving device (40, 42), in the unloading station, is tilted through 30° to 90° with respect to the vertical and is shaken, for the purpose of removing the solid pyrolysis residues which are capable of flowing, after which the metal constituents which have remained attached
10 to the receiving rods (42) are pulled off these rods.

6. The process as claimed in claim 4, characterized in that
in the unloading station the receiving containers (50, 51) are removed from the receiving device (56) in the
15 vertical direction and the solid pyrolysis residues situated therein are discharged by suitable tilting and shaking or suction, after which they are loaded again and are inserted into a receiving device (50) again.

20 7. A plant for carrying out the process as claimed in claims 1 to 6, comprising
- only one pyrolysis furnace (1), which is a double-walled furnace which can be heated from the outside by electrical means or by means of an oil or gas burner (7)

and has helical transverse walls (5) which lead from the bottom upward and form a helical duct (6) for the hot air, which is passed helically from the bottom upward and is extracted at the upper end of the furnace, and which for discharging the pyrolysis gases has a discharge pipe (20) which leads vertically out of the furnace dome (10) provided at the top side of the furnace,

- the furnace having a vertically lowerable base (45) and being designed so that it can be loaded and unloaded vertically from below via this base,

- and the cylindrical furnace inner wall (4) being equipped with heat-emitting plates or radiation ribs (31) which face radially inward.

8. The plant as claimed in claim 7, characterized in that at least one material-receiving device (40, 50) is provided, which can be attached to the top side of the vertically moveable base (45) or is part of the base, therefore at the same time is the closure bottom plate (45) of the furnace (1).

9. The plant as claimed in claim 8, characterized in that for a furnace a plurality of furnace bases (45, 47), each

with a receiving device for the material to be pyrolyzed
arranged fixedly thereon are provided.

10. The plant as claimed in claim 8, characterized in that
5 only one furnace base (45, 47) and a plurality of
separate receiving devices (40, 50) which interact with
this base are provided, which receiving devices are
designed so that they could be rapidly attached to the
bottom plate (45) of the furnace base by means of screws.

10

11. The plant as claimed in claim 8, characterized in that
for the pyrolysis of used tires (44), the receiving
device (40) has receiving rods (42), which are attached
to a bottom plate (41) and project vertically, for
15 stacking rows of the tires (44) on top of one another.

15

12. The plant as claimed in claim 11, characterized in that
for the pyrolysis of comminutable material which is
capable of forming a bulk material, at least one
20 stackable receiving container (41) with lateral wall
openings is provided as a perforated-plate container.

20

13. The plant as claimed in claim 7, characterized in that
for reliable introduction of the receiving devices (40,

50), at least three introduction rods (43) which are arranged vertically close to the outer circumference on the base plate (41) thereof are provided on the receiving rods, while vertical introduction rails (33), which are
5 arranged at a radial distance from the furnace inner wall (4) and have opening-side introduction slopes (34), are arranged in the pyrolysis furnace (1).

14. The plant as claimed in claim 7, characterized in that
10 the upper hot-air or off-gas pipe (11) and/or the line from a heat exchanger to an introduction connection piece or supply pipe (16) is guided at the bottom end of the furnace (1).

15 15. The plant as claimed in claim 7, characterized in that the helical transverse walls (5) of the helical duct (6) are only welded onto the furnace inner wall (4), while they are connected to the furnace outer wall (3) in a thermally insulated manner, and in that the furnace walls
20 (3, 4) in the vicinity of the burner (7) are designed with fire clay, and the furnace overall has a thermally insulating jacket (30) on the outside.

16. The use of pyrolyzed carbon as a fire-extinguishing means, for example for extinguishing burning oil, large fires, forest and bush fires, and fires on water.

5 17. The use of pyrolyzed carbon for preventing oil pollution in particular after an oil tanker accident, carbon being scattered on the slick of oil and the carpet of carbon which has sucked itself full of oil, floats on top of the water and is of considerably reduced area is scooped out
10 and the separation into oil and carbon is carried out again by subsequent pyrolysis.